

## METHOD AND APPARATUS FOR HIGH FLY WRITE DETECTION IN A DISK DRIVE

5

### CROSS-REFERENCE TO RELATED APPLICATION

Priority is claimed from U.S. Provisional Patent Application Serial No. 60/239,509 filed October 11, 2000, which is incorporated by reference herein in its entirety.

### FIELD OF THE INVENTION

10

The present invention relates to computer disk drives. More particularly, the present invention relates to a method and apparatus for detecting high fly write conditions in a computer disk drive.

### BACKGROUND OF THE INVENTION

15

Computer disk drives store information on magnetic disks. Typically, the information is stored on each disk in concentric tracks, divided into sectors. Information is written to and read from a disk by a head (or transducer), which is mounted on an actuator arm capable of moving the head radially over the disk. Accordingly, the movement of the actuator arm allows the head to access different tracks. The disk is rotated by a spindle motor at a high speed, allowing the head to access different sectors on the disk. The head may include separate or integrated read and write elements.

20

In a typical computer disk drive, the head generally rides above the surface of the disk on a cushion of air that is created by the movement of the disk under the head. The distance of the head from the surface of the magnetic disk is known as the flying height of the head.

It is important to maintain the flying height of the head within a desired range. For example, if the head flies at too low a height, it is more likely to come into contact with the magnetic disk causing a loss of stored data. It is also important to ensure that the head does not fly at too great a height. When the head is consistently at too great a distance from the magnetic disk, the head is said to be in a "high flying" condition. A "high fly write condition" occurs when the head is suddenly at too great a height from the disk to reliably perform write operations.

There are many reasons why a high flying condition may occur. For example, the head may strike a particle on the disk surface causing a temporary change in the flying height of the head. As another example, a particle may become attached to the head which causes the aerodynamic characteristics of the head (more properly, its slider) to change such that the flying height increases.

Data written to a magnetic storage disk for storage while a head is experiencing a high fly write condition may be lost. This is because the strength of the magnetic field generated by the write element decreases exponentially with distance. Accordingly, where the head is at too great a distance from the surface of the magnetic disk (*e.g.*, during a high fly write event), the magnetic field produced may not be strong enough to induce the desired magnetic transitions in the storage disk. Therefore, it is important to detect a high fly write event in a computer disk drive, so that data written during a high fly write condition may be rewritten when the flying height has returned to normal or so that some other remedial action may be taken.

In prior disk drive systems, in order to verify that data was properly written to a disk surface (e.g., to ensure that data was not written during a high fly write condition), a relatively inefficient process was used. That is, data to be stored onto the disk surface would be provided to the write element and the write element would write the data onto the disk surface in the form of magnetic polarity transitions. After the write operation was completed, the disk would make a complete revolution and the information written onto the disk surface would be read. The data recovered from the disk surface was then compared with the original data to be stored onto the disk surface to verify that it matched.

While the aforementioned method provided an accurate way of detecting situations where data was not properly written onto the disk surface, it was very slow. In fact, such a method is not acceptable for modern disk drive performance requirements.

Accordingly, it would be advantageous to provide an accurate method and apparatus for detecting high fly write conditions in a relatively efficient manner. Furthermore, it would be advantageous to provide such a method and apparatus that can be implemented at an acceptable cost and that is reliable in operation.

## SUMMARY OF THE INVENTION

The present invention is designed to minimize the aforementioned problems and meet the aforementioned, and other, needs.

Amplitudes of automatic gain control (AGC) fields are used in connection with determining whether a high fly write condition exists in a disk drive. More specifically, the amplitude of an AGC field read by a head is generally related to the flying height of the head.